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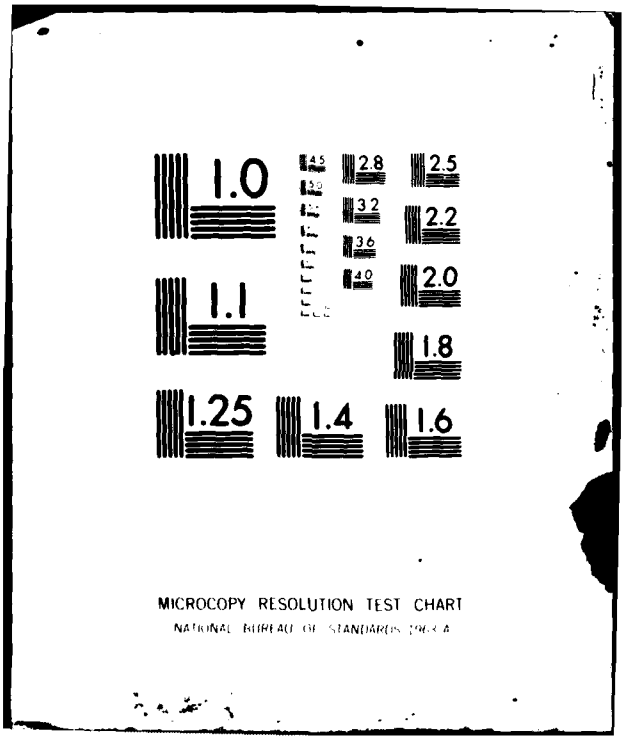
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STUDY OF CRYOGENIC TECHNIQUES FOR OPERATING HYDROGEN MASERS

Contract N00014-77-C-0777

Interim Report
For the period from 1 February 1980 to 30 April 1981

May 1981

Prepared for
OFFICE OF NAVAL RESEARCH
800 N. Quincy Street
Arlington, VA 22217

Prepared by
Dr. Robert F. C. Vessot

Smithsonian ~~Institution~~
Astrophysical Observatory
Cambridge, Massachusetts 02138

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Atomic Hydrogen Maser Oscillator - Frequency Standard - Cryogenic Cooling - Superconducting Magnetic Shields - Low Noise Electronics

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Cryogenic Techniques are applied to the Atomic Hydrogen Maser Frequency Standard to extend the storage time of the atoms and reduce the thermal noise accompanying the signal and within the resonance linewidth. Oscillation has been achieved below 25K using wall coatings of frozen CF_4. This method will be used to determine the wall interaction for Atomic Hydrogen on a variety of other surfaces. A pair of new masers is under construction so that frequency stability improvement can be measured. Stability at the 1×10^{-16} level in $\Delta f/f$ for averaging time intervals of 1,000 seconds is expected at temperatures below 30K.

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A STUDY OF CRYOGENIC TECHNIQUES FOR OPERATING HYDROGEN MASERS

ONR CONTRACT NO. N00014-77-C-0777

Principal Investigator: R.F.C. Vessot
Co-Investigator: E.M. Mattison

CONTRACT DESCRIPTION:

The objective of our work is to study the interaction of atomic hydrogen on various surface coatings frozen in place at low temperatures. We are interested in seeing how the hyperfine structure is altered by the collision process. We will determine the average phase advance (or retardation) and the phase dispersion by measuring the wall frequency shift and line broadening of the ($F = 1, m_f = 0 \longrightarrow F = 0, m_f = 0$) transition in atomic hydrogen using the maser technique under both oscillating conditions.

The nature of the interaction potentials between atomic hydrogen and various materials is the main scientific objective of this study.

We will use the atomic hydrogen maser operating at low temperatures, $4K < T < 30K$, and will apply surface coatings to the storage volume by introducing gassesinto the storage volume through a nozzle that is locally warmed for a brief time. The nozzle is designed to apply the coating uniformly to the storage volume, where the gas molecules will freeze in place to form the storage surface. Wall collision frequency shifts and relaxation processes will be measured as a function of temperature for various coatings.

During the past contract period we have completely redesigned and built two cryostats containing a magnetically shielded working volume sufficiently large enough to enclose a TE-011 mode cavity resonator (29 cm long x 29 cm diameter). The r.f. dissociator and state selection system has been built and tested. The gas handling system for introducing wall coatings has also been built. Electronic circuits for controlling the cavity temperature and magnetic field are under construction. A data handling system based on a Tektronix 4052 Microcomputer system is being programmed to control the system and record and reduce the data.

No further publications have resulted in the past contract period. Only the usual problems of procurement delays and the perversity of vacuum systems have been encountered.

We do not expect to have any unspent funds at the end of the contract period. We have no graduate students at work on this program.

A listing of all other Federal grant or contract support is appended.

OTHER SUPPORT TO SAO

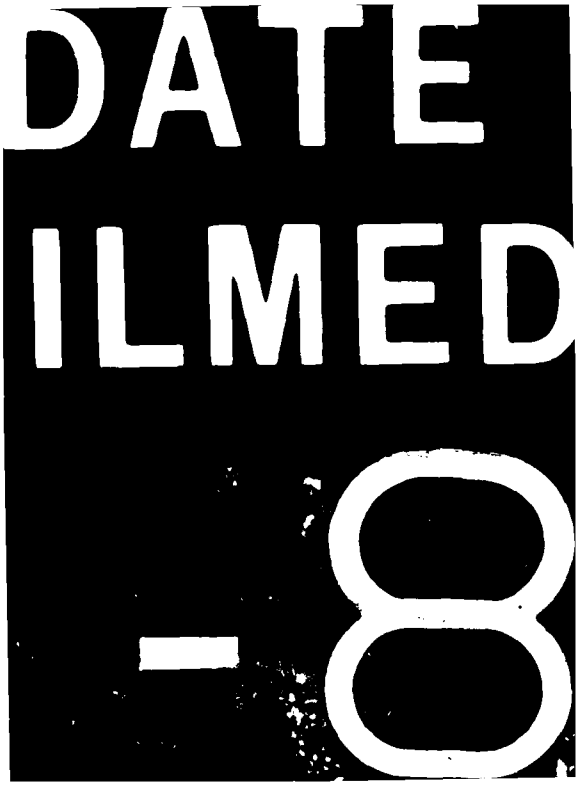
GRANT NAG-8006	NASA-MARSHALL SPACE FLIGHT CENTER	TIME AND FREQUENCY TRANSFER STUDY.
GRANT NAG-8012	NASA-MARSHALL " "	DISSOCIATORS FOR LOW TEMPERATURE ATOMIC HYDROGEN MASERS
CONTRACT N00014-79-C-0718	ONR-NRL	ADM PASSIVE HYDROGEN MASERS
CONTRACT 954938	JPL-PASADENA, CA.	BUILD HYDROGEN MASERS AND MASER R & D.
CONTRACT 955633	JPL-PASADENA, CA.	STUDY CRYOGENIC HYDROGEN MASER OPERATION.
CONTRACT TKK801	UNIVERSITY OF TOKYO, JAPAN	BUILD ONE HYDROGEN MASER SYSTEM

SUPPORT BY SMITHSONIAN INSTITUTION

S&E, SI RESTRICTED	FOUR LINK TIME CORRELATED DOPPLER SYSTEM FOR GRAVITATIONAL WAVE DETECTION.

SUPPORT BY CENTER for ASTROPHYSICS

NSG-7176	NASA Core Grant	GRAVITATIONAL WAVE DETECTION USING DEEP SPACE DOPPLER TECHNIQUES.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